

CLAIMS

1. A gas turbine installation including a compressor for compressing air supplied thereto and discharging the compressed air, a combustor for burning fuel together with the air discharged from said compressor, and a turbine driven by combustion gas generated by said combustor, said gas turbine installation comprising:

a spraying apparatus, which is provided in an air suction chamber disposed on the upstream side of said compressor, and which is used for spraying water droplets to air to be supplied to said compressor thereby making the temperature of the air to be supplied to said compressor lower than the temperature of atmospheric air, said sprayed water droplets being introduced in said compressor together with the air whose temperature has been lowered and being evaporated in a period in which said water droplets flow down in said compressor together with the air;

a water adding apparatus for adding water to the compressed air discharged from said compressor, said compressed air containing moisture added in the form of water droplets by said spraying apparatus;

a regenerator for receiving the compressed air containing moisture added by said water adding apparatus and heating the compressed air by using a gas turbine

exhaust gas as a heat source; and

a path through which the compressed air heated by said regenerator is supplied to said combustor.

2. A gas turbine installation including a compressor for compressing air supplied thereto and discharging the compressed air, a combustor for burning fuel together with the air discharged from said compressor, and a turbine driven by combustion gas generated by said combustor, said gas turbine installation comprising:

a spraying apparatus, which is provided in an air suction chamber disposed on the upstream side of said compressor, and which is used for spraying water droplets to air to be supplied to said compressor, evaporating part of the sprayed water droplets until the water droplets are led in said compressor, and evaporating the non-evaporated water droplets led in said compressor together with the air in a period in which the water droplets flow down in said compressor together with the air;

a water adding apparatus for adding water to the compressed air discharged from said compressor, said compressed air containing moisture added in the form of water droplets by said spraying apparatus;

a regenerator for receiving the compressed air containing moisture added by said water adding apparatus and heating the compressed air by using a gas turbine

exhaust gas as a heat source; and

a path through which the compressed air heated by said regenerator is supplied to said combustor.

3. A gas turbine installation including a compressor for compressing air supplied thereto and discharging the compressed air, a combustor for burning fuel together with the air discharged from said compressor, and a turbine driven by combustion gas generated by said combustor, said gas turbine installation comprising:

a spraying apparatus, which is provided in an air suction chamber disposed on the upstream side of said compressor, and which is used for spraying water droplets to air to be supplied to said compressor, evaporating part of the sprayed water droplets until the water droplets are led in said compressor, and evaporating the non-evaporated water droplets led in said compressor together with the air in a period in which the water droplets flow down in said compressor together with the air;

a water adding apparatus for adding water to the compressed air discharged from said compressor, said compressed air containing moisture added in the form of water droplets by said spraying apparatus;

a regenerator for receiving the compressed air containing moisture added by said water adding apparatus and heating the compressed air by using a gas turbine

exhaust gas as a heat source;

a path through which the compressed air heated by said regenerator is supplied to said combustor; and

a path used for recovering moisture from combustion exhaust gas having passed through said regenerator and supplying the recovered moisture to at least one of said spraying apparatus and said water adding apparatus.

4. A gas turbine installation according to claim 1, wherein said spraying apparatus comprises sprayers which are arranged in a plurality of steps along the flow of the air in said suction air chamber in such a manner that the temperature of water sprayed from one, positioned on the downstream side, of said sprayers is higher than the temperature of water sprayed from one, positioned on the upstream side, of said sprayers.

5. A gas turbine installation according to claim 1, further comprising:

a control unit for controlling the amount of water added to air in such a manner that the amount of water sprayed to the air by said spraying apparatus is in a range of $1/50$ to $1/5$ of the amount of water added to the compressed air by said water adding apparatus.

6. A gas turbine installation according to claim 1, further comprising:

a control unit for controlling the amount of water added to air in such a manner that the amount of water sprayed to the air by said spraying apparatus is in a range of $1/50$ to $1/5$ of the amount of water added to the compressed air by said water adding apparatus;

wherein the ratio of the amount of circulated water to and from said water adding apparatus to the amount of water added to the compressed air by said water adding apparatus is controlled to be in a range of 70% to 95%.

7. A gas turbine installation according to claim 1, wherein the ratio of the amount of water sprayed to the air by said spraying apparatus to the flow rate in weight of the air is controlled to be in a range of 0.2% to 5.0%, and the ratio of the amount of water added to the compressed air by the water adding apparatus to the flow rate in weight of the compressed air discharged from said compressor is controlled to be in a range of 30% or less.

8. A gas turbine installation including a compressor for compressing air supplied thereto and discharging the compressed air, a combustor for burning fuel together with the air discharged from said compressor, and a turbine driven by combustion gas generated by said combustor, said gas turbine installation comprising:

a spraying apparatus, which is provided in an air suction chamber disposed on the upstream side of said

compressor, and which is used for spraying water droplets to air to be supplied to said compressor, evaporating part of the sprayed water droplets until the water droplets are led in said compressor, and evaporating the non-evaporated water droplets led in said compressor together with the air in a period in which the water droplets flow down in said compressor together with the air;

a water adding apparatus for adding water to the compressed air discharged from said compressor, said compressed air containing moisture added in the form of water droplets by said spraying apparatus;

a regenerator for receiving the compressed air containing moisture added by said water adding apparatus and heating the compressed air by using a gas turbine exhaust gas as a heat source;

a path through which the compressed air heated by said regenerator is supplied to said combustor; and

a control unit for controlling the temperature of water in such a manner that the temperature of water supplied to said water adding apparatus is higher than the temperature of water supplied to said spraying apparatus.

9. A gas turbine installation including a compressor for compressing air supplied thereto and discharging the compressed air, a combustor for burning fuel together with the air discharged from said compressor, and a turbine

driven by combustion gas generated by said combustor, said gas turbine installation comprising:

a spraying apparatus, which is provided in an air suction chamber disposed on the upstream side of said compressor, and which is used for spraying water droplets to air to be supplied to said compressor, evaporating part of the sprayed water droplets until the water droplets are led in said compressor, and evaporating the non-evaporated water droplets led in said compressor together with the air in a period in which the water droplets flow down in said compressor together with the air;

a water adding apparatus for adding water to the compressed air discharged from said compressor, said compressed air containing moisture added in the form of water droplets by said spraying apparatus;

a regenerator for receiving the compressed air containing moisture added by said water adding apparatus and heating the compressed air by using a gas turbine exhaust gas as a heat source;

a path through which the compressed air heated by said regenerator is supplied to said combustor;

a water supply path used for recovering moisture from combustion exhaust gas having passed through said regenerator and supplying the recovered moisture to said spraying apparatus and said water adding apparatus; and

a cooling apparatus for cooling the compressed air flowing on the upstream side of said water adding apparatus by heat exchange with the water supplied to said water adding apparatus.

10. A gas turbine installation according to claim 1, further comprising, in place of said water supply path, added water supply path used for recovering moisture from combustion exhaust gas having passed through said regenerator and supplying the recovered moisture to said water adding apparatus; and a spray water supply path through which spray water is led from an external source outside the system in said spraying apparatus.

11. A gas turbine installation including a compressor for compressing air supplied thereto and discharging the compressed air, a combustor for burning fuel together with the air discharged from said compressor, and a turbine driven by combustion gas generated by said combustor, said gas turbine installation comprising:

a spraying apparatus, which is provided in an air suction chamber disposed on the upstream side of said compressor, and which is used for spraying water droplets to air to be supplied to said compressor, evaporating part of the sprayed water droplets until the water droplets are led in said compressor, and evaporating the non-evaporated water droplets led in said compressor together with the air

in a period in which the water droplets flow down in said compressor together with the air;

a water adding apparatus for adding water to the compressed air discharged from said compressor, said compressed air containing moisture added in the form of water droplets by said spraying apparatus;

a regenerator for receiving the compressed air containing moisture added by said water adding apparatus and heating the compressed air by using a gas turbine exhaust gas as a heat source;

said combustor to which the compressed air heated by said regenerator is supplied;

a water supply path used for recovering moisture from combustion exhaust gas having passed through said regenerator and supplying the recovered moisture to said spraying apparatus and said water adding apparatus; and

a supplied water heater for heating water to be supplied to said water adding apparatus by using combustion exhaust gas having passed through said regenerator as a heat source.

12. A gas turbine installation according to claim 1, further comprising:

a control unit for reducing, upon decrease in load, the amount of water to be added to the compressed air by said water adding apparatus and then reducing the amount of

water to be sprayed to the air by said spraying apparatus.

13. A gas turbine installation according to claim 1, further comprising:

a control unit for increasing, upon increase in load, the amount of water to be sprayed to the air by said spraying apparatus and then increasing the amount of water to be added to the compressed air by said water adding apparatus.

14. An efficiency increasing apparatus, provided in a gas turbine installation, for recovering thermal energy of gas turbine exhaust gas thereby improving power generating efficiency, said gas turbine installation including a compressor for compressing air supplied thereto and discharging the compressed air, a combustor for burning fuel together with the air discharged from said compressor, and a turbine driven by combustion gas generated by said combustor;

said efficiency increasing apparatus comprising:

a spraying apparatus, which is provided in an air suction chamber disposed on the upstream side of said compressor, and which is used for spraying water droplets to air to be supplied to said compressor, evaporating part of the sprayed water droplets until the water droplets are led in said compressor, and evaporating the non-evaporated water droplets led in said compressor together with the air

in a period in which the water droplets flow down in said compressor together with the air;

a water adding apparatus for adding water to the compressed air discharged from said compressor, said compressed air containing moisture added in the form of water droplets by said spraying apparatus; and

a regenerator for receiving the compressed air containing moisture added by said water adding apparatus and heating the compressed air by using a gas turbine exhaust gas as a heat source.

15. An efficiency increasing apparatus, provided in a gas turbine installation, for recovering thermal energy of gas turbine exhaust gas thereby improving power generating efficiency, said gas turbine installation including a compressor for compressing air supplied thereto and discharging the compressed air, a combustor for burning fuel together with the air discharged from said compressor, and a turbine driven by combustion gas generated by said combustor;

said efficiency increasing apparatus comprising:

a spraying apparatus, which is provided in an air suction chamber disposed on the upstream side of said compressor, and which is used for spraying water droplets to air to be supplied to said compressor, evaporating part of the sprayed water droplets until the water droplets are

led in said compressor, and evaporating the non-evaporated water droplets led in said compressor together with the air in a period in which the water droplets flow down in said compressor together with the air;

a water adding apparatus for adding water to the compressed air discharged from said compressor, said compressed air containing moisture added in the form of water droplets by said spraying apparatus;

a regenerator for receiving the compressed air containing moisture added by said water adding apparatus and heating the compressed air by using a gas turbine exhaust gas as a heat source; and

a path used for recovering moisture from combustion exhaust gas having passed through said regenerator and supplying the recovered moisture to at least the water adding apparatus of a group of said spraying apparatus and said water adding apparatus.

16. An efficiency increasing apparatus according to claim 14, further comprising:
a control unit for controlling the amount of water added to air in such a manner that the amount of water sprayed to the air by said spraying apparatus is in a range of $1/50$ to $1/5$ of the amount of water sprayed to the compressed air by said water adding apparatus.